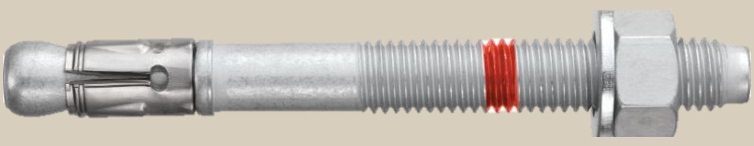
HST-3
EXPANSION ANCHOR

Technical Datasheet

Update: May-19



HST3 Expansion anchor

Ultimate-performance expansion anchor for cracked concrete and seismic

Anchor version

HST3
HST3-R
(M8-M20)

HST3-BW
HST3-R-BW
(M8-M24)

Benefits

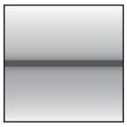
- Highest resistance for reduced member thickness, short spacing and edge distances
- Increased undercut percentage in combination with optimized coating
- Suitable for non-cracked and cracked concrete
- Normal and lightweight concrete with concrete compressive strength range from 2,500 psi (17.2 MPa) to 8,500 psi (58.6 MPa)
- Highly reliable and safe anchor for structural seismic design
- Product and length identification mark facilitates quality control and inspection

Base material

Concrete (non-cracked)

Concrete (cracked)

Load conditions

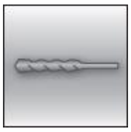


Static/ quasi-static

Seismic

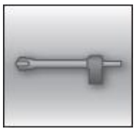
Fire resistance

Installation conditions



Hammer drilled holes

Diamond drilled holes



Hollow drill-bit drilling

Other information

CE conformity

FM approved

Uniform Evaluation Service

Approvals / certificates

Description	Authority / Laboratory	No. / date of issue
Shock approval	FOCP, Zurich	BZS D 08-602 / 2016-08-17
ACI 318 assessment	IAPMO UES, USA	ER-578 / 2019-28-02

Data source

Technical data in this section is based on evaluation report ER-578 by IAPMO UES according to ACI 355.2 and ICC-ES AC193, except for the following - Diamond drilled holes, Hollow-drill bit, shallow embedment data for M10 to M16, Seismic filling set, and the -BW version.

Additional data for Diamond drilled holes, Hollow-drill bit, shallow embedment data for M10 to M16, Seismic filling set, and the -BW version, is based on technical assessment of testing done for ETA-98/0001 and evaluated by Hilti for designs in accordance with ACI 318-14 chapter 17. Published technical data is not contained in an external evaluation report (i.e. ICC-ES or IAPMO-UES) or other approval at this time, and can be used as Hilti Technical Data only.

Anchor performance

Design information for tension [a] for HST3

Design parameter			Nominal anchor diameter (mm)							
			M8	M10		M12		M16		M20
Anchor O.D.	d_a	mm	**8**	**10**		**12**		**16**		**20**
Effective min. embedment	h_{ef}	mm	47	40	60	50	70	65	85	101
Tension, steel failure modes										
Strength reduction factor for steel in tension [b]	$\phi_{sa,N}$		0.75							
Min. specified yield strength, threads	$f_{ya,threads}$	N/mm²	640	640		640		576		560
Min. specified ult. strength, threads	$f_{uta,threads}$	N/mm²	800	800		800		720		700
Effective-cross sectional steel area in tension, threads	$A_{se,N,thrd}$	mm²	36.6	58.0		84.3		157.0		245.0
Min. specified yield strength, neck	$f_{ya,neck}$	N/mm²	688	740		731		688		634
Min. specified ult. strength, neck	$f_{uta,neck}$	N/mm²	800	860		850		800		740
Effective-cross sectional steel area in tension, neck	$A_{se,N,neck}$	mm²	24.6	37.8		53.1		95.0		167.9
Nominal steel strength in tension	N_{sa}	kN	19.7	32.5		45.1		76.0		124.2
Tension, concrete failure modes										
Anchor category			1							
Strength reduction factor for concrete failure in tension, Condition A [c]	$\phi_{c,N}$		0.75							
Strength reduction factor for concrete failure in tension, Condition B [c]	$\phi_{c,N}$		0.65							
Strength reduction factor for pullout failure in tension, Condition A and B [c]	$\phi_{p,N}$		0.65							
Effectiveness factor for uncracked concrete	k_{uncr}		10.0	11.3	10.0	11.3	10.0	11.3	10.0	
Effectiveness factor for cracked concrete	k_{cr}		7.1	8.8	7.1			8.8	7.1	8.8
Modification factor for anchor resistance, tension, uncracked conc. [d]	$\psi_{c,N}$		1.0							
Critical edge distance	c_{ac}	mm	71	95	115	90	110	115	128	192
Pullout strength in uncracked concrete [e]	$N_{p,uncr}$	kN	11.0	NA	NA	NA	NA	NA	NA	NA
Pullout strength in cracked concrete [e]	$N_{p,cr}$	kN	8.5	NA	NA	NA	NA	NA	NA	NA
Pullout strength in cracked concrete, seismic [e]	$N_{p,eq}$	kN	8.5	-	NA	-	NA	-	19.9	36.6

a) Design information in accordance with ACI 355.2-07 and AC193

b) The HST3 carbon steel anchor is considered a ductile steel element as defined by ICC-ES AC193 section 6.3.6.

c) For use with the load combinations of ACI 318-14 section 5.3. Condition B applies where supplementary reinforcement in conformance with ACI 318-14 section 17.3.3 c) is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

d) For all design cases, $\psi_{c,N} = 1.0$. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked (k_{uncr}) concrete must be used.

e) For all design cases, $\psi_{c,P}$ = 1.0. Tabular value for pullout strength is for a concrete compressive strength of 17.2 MPa. Pullout strength for concrete compressive strength greater than 17.2 MPa may be increased by multiplying the tabular pullout strength by $(f'_c / 17.2)^{0.5}$. NA (not applicable) denotes that pullout strength does not need to be considered for design.

Design information for shear [a] for HST3

Design parameter			Nominal anchor diameter (mm)							
			M8	M10		M12		M16		M20
Anchor O.D.	d_a	**mm**	**8**	**10**		**12**		**16**		**20**
Effective min. embedment	h_{ef}	mm	47	40	60	50	70	65	85	101
Shear, steel failure modes										
Strength reduction factor for steel in shear [b]	$\phi_{sa,V}$		0.65							
Nominal steel strength in shear [f]	V_{sa}	kN	12.9	19.1	19.1	26.2	27.6	45.3	47.6	64.3
Nominal steel strength in shear, seismic [f]	$V_{sa,eq}$	kN	11.5	-	19.1	-	24.9	-	43.1	64.3
Nominal steel strength in shear, w/ Seismic/Filling Set [f]	V_{sa}	kN	16.6	-	25.8	-	39.0	-	60.9	100.4
Nominal steel strength in shear, seismic, w/ Seismic/Filling Set [f]	$V_{sa,eq}$	kN	16.6	-	25.8	-	39.0	-	60.9	100.4
Shear, concrete failure modes										
Strength reduction factor for concrete breakout failure in shear, Condition A [c]	$\phi_{c,V}$		0.75							
Strength reduction factor for concrete breakout failure in shear, Condition B [c]	$\phi_{c,V}$		0.70							
Strength reduction factor for pryout failure in shear, Condition A and B [c]	$\phi_{p,V}$		0.70							
Load bearing length of anchor in shear	ℓ_e	mm	47	40	60	50	70	65	85	101
Effectiveness factor for pryout	k_{cp}	-	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0

f) Design information in accordance with ACI 355.2-07 and AC193

g) The HST3 carbon steel anchor is considered a ductile steel element as defined by ICC-ES AC193 section 6.3.6.

h) For use with the load combinations of ACI 318-14 section 5.3. Condition B applies where supplementary reinforcement in conformance with ACI 318-14 section 17.3.3 c) is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

f) Shear and seismic shear tests are all performed in cracked concrete member according to ICC-ES AC193 section 9.4 and 9.6 respectively. Value of $V_{sa(,eq)} < 0.6\ A_{se,V}\ f_{uta}$ for all cases.

Design information for tension a) for HST3-R

Design parameter			Nominal anchor diameter (mm)							
			M8	**M10**		**M12**		**M16**		**M20**
Anchor O.D.	d_a	**mm**	**8**	**10**		**12**		**16**		**20**
Effective min. embedment	h_{ef}	mm	47	40	60	50	70	65	85	101
Tension, steel failure modes										
Strength reduction factor for steel in tension b)	$\phi_{sa,N}$		0.75							
Min. specified yield strength, threads	$f_{ya,threads}$	N/mm^2	576	568		568		520		520
Min. specified ult. strength, threads	$f_{uta,threads}$	N/mm^2	720	710		710		650		650
Effective-cross sectional steel area in tension, threads	$A_{se,N,thrd}$	mm^2	36.6	58.0		84.3		157.0		245.0
Min. specified yield strength, neck	$f_{ya,neck}$	N/mm^2	619	654		688		628		593
Min. specified ult. strength, neck	$f_{uta,neck}$	N/mm^2	720	760		800		730		690
Effective-cross sectional steel area in tension, neck	$A_{se,N,neck}$	mm^2	24.6	37.8		53.1		95.0		167.9
Nominal steel strength in tension	N_{sa}	kN	17.7	28.7		42.5		69.4		115.8
Tension, concrete failure modes										
Anchor category			1							
Strength reduction factor for concrete failure in tension, Condition A c)	$\phi_{c,N}$		0.75							
Strength reduction factor for concrete failure in tension, Condition B c)	$\phi_{c,N}$		0.65							
Strength reduction factor for pullout failure in tension, Condition A and B c)	$\phi_{p,N}$		0.65							
Effectiveness factor for uncracked concrete	k_{uncr}		10.0	11.3	10.0	11.3	10.0	11.3	10.0	
Effectiveness factor for cracked concrete	k_{cr}		7.1	8.8	7.1			8.8	7.1	8.8
Modification factor for anchor resistance, tension, uncracked conc. d)	$\psi_{c,N}$		1.0							
Critical edge distance	c_{ac}	mm	71	95	115	90	110	115	128	192
Pullout strength in uncracked concrete e)	$N_{p,uncr}$	kN	11.0	NA	NA	NA	NA	NA	NA	NA
Pullout strength in cracked concrete e)	$N_{p,cr}$	kN	8.5	NA	NA	NA	NA	NA	NA	NA
Pullout strength in cracked concrete, seismic e)	$N_{p,eq}$	kN	8.5	-	NA	-	NA	-	19.9	36.6

a) Design information in accordance with ACI 355.2-07 and AC193

b) The HST3 carbon steel anchor is considered a ductile steel element as defined by ICC-ES AC193 section 6.3.6.

c) For use with the load combinations of ACI 318-14 section 5.3. Condition B applies where supplementary reinforcement in conformance with ACI 318-14 section 17.3.3 c) is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

d) For all design cases, $\psi_{c,N}$ = 1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked (k_{uncr}) concrete must be used.

e) For all design cases, $\psi_{c,P}$ = 1.0. Tabular value for pullout strength is for a concrete compressive strength of 17.2 MPa. Pullout strength for concrete compressive strength greater than 17.2 MPa may be increased by multiplying the tabular pullout strength by $(f'_c / 17.2)^{0.5}$. NA (not applicable) denotes that pullout strength does not need to be considered for design.

Design information for shear [a)] for HST3-R

Design parameter			Nominal anchor diameter (mm)							
			M8	**M10**		**M12**		**M16**		**M20**
Anchor O.D.	d_a	**mm**	**8**	**10**		**12**		**16**		**20**
Effective min. embedment	h_{ef}	mm	47	40	60	50	70	65	85	101
Shear, steel failure modes										
Strength reduction factor for steel in shear [b)]	$\phi_{sa,V}$		0.65							
Nominal steel strength in shear [f)]	V_{sa}	kN	10.1	23.1	24.4	27.9	28.9	44.1	61.2	79.2
Nominal steel strength in shear, seismic [f)]	$V_{sa,eq}$	kN	9.8	-	22.1	-	28.9	-	60.7	51.5
Nominal steel strength in shear, w/ Seismic/Filling Set [f)]	V_{sa}	kN	19.5	-	28.4	-	44.3	-	70.2	102.7
Nominal steel strength in shear, seismic, w/ Seismic/Filling Set [f)]	$V_{sa,eq}$	kN	19.5	-	28.4	-	44.3	-	70.2	102.7
Shear, concrete failure modes										
Strength reduction factor for concrete breakout failure in shear, Condition A [c)]	$\phi_{c,V}$		0.75							
Strength reduction factor for concrete breakout failure in shear, Condition B [c)]	$\phi_{c,V}$		0.70							
Strength reduction factor for pryout failure in shear, Condition A and B [c)]	$\phi_{p,V}$		0.70							
Load bearing length of anchor in shear	ℓ_e	mm	47	40	60	50	70	65	85	101
Effectiveness factor for pryout	k_{cp}	-	1.0	1.0	1.0	1.0	2.0	2.0	2.0	2.0

f) Design information in accordance with ACI 355.2-07 and AC193

g) The HST3 carbon steel anchor is considered a ductile steel element as defined by ICC-ES AC193 section 6.3.6.

h) For use with the load combinations of ACI 318-14 section 5.3. Condition B applies where supplementary reinforcement in conformance with ACI 318-14 section 17.3.3 c) is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

f) Shear and seismic shear tests are all performed in cracked concrete member according to ICC-ES AC193 section 9.4 and 9.6 respectively. Value of $V_{sa(,eq)} < 0.6\ A_{se,V}\ f_{uta}$ for all cases.

Materials

Mechanical properties

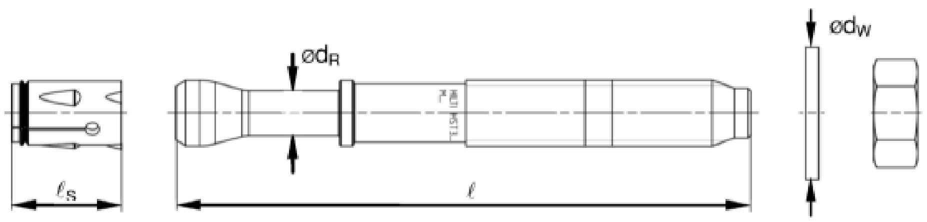
Anchor size			M8	M10	M12	M16	M20
Nominal tensile strength $f_{uk,thread}$	HST3/HST3-BW	[N/mm²]	800	800	800	720	700
	HST3-R/HST3-R-BW		720	710	710	650	650
Yield strength $f_{yk,thread}$	HST3/HST3-BW	[N/mm²]	640	640	640	576	560
	HST3-R/HST3-R-BW		576	568	568	520	520
Stressed cross-section A_s		[mm²]	36,6	58,0	84,3	157	245
Moment of resistance W		[mm³]	31,2	62,3	109	277	541
Char, bending resistance $M^0_{Rk,s}$	HST3/HST3-BW	[Nm]	30	60	105	240	457
	HST3-R/HST3-R-BW		27	53	93	216	425

Material quality

Part		Material
Expansion sleeve	HST3/HST3-BW	M10, M16: Galvanized or Stainless steel M8, M12, M20 Stainless steel
	HST3-R/HST3-R-BW	Srainless steel A4
Bolt	HST3/HST3-BW	Carbon steel, galvanized, coated (transparent)
	HST3-R/HST3-R-BW	Stainless steel A4, cone coated (transparent)
Washer	HST3/HST3-BW	Galvanized
	HST3-R/HST3-R-BW	Stainless steel A4
Hexagon nut	HST3/HST3-BW	Strength class 8
	HST3-R/HST3-R-BW	Stainless steel A4, coated

Anchor dimensions of HST3, HST3-R

Anchor size			M8	M10	M12	M16	M20
Maximum length of anchor	$\ell_{max} \leq$	[mm]	260	280	350	475	450
Shaft diameter at the cone	d_R	[mm]	5,60	6,94	8,22	11,00	14,62
Length of expansion sleeve	ℓ_s	[mm]	13,6	16,0	20,0	25,0	28,3
Diameter of washer	$d_w \geq$	[mm]	5.60	6.94	8.22	11.00	14.62

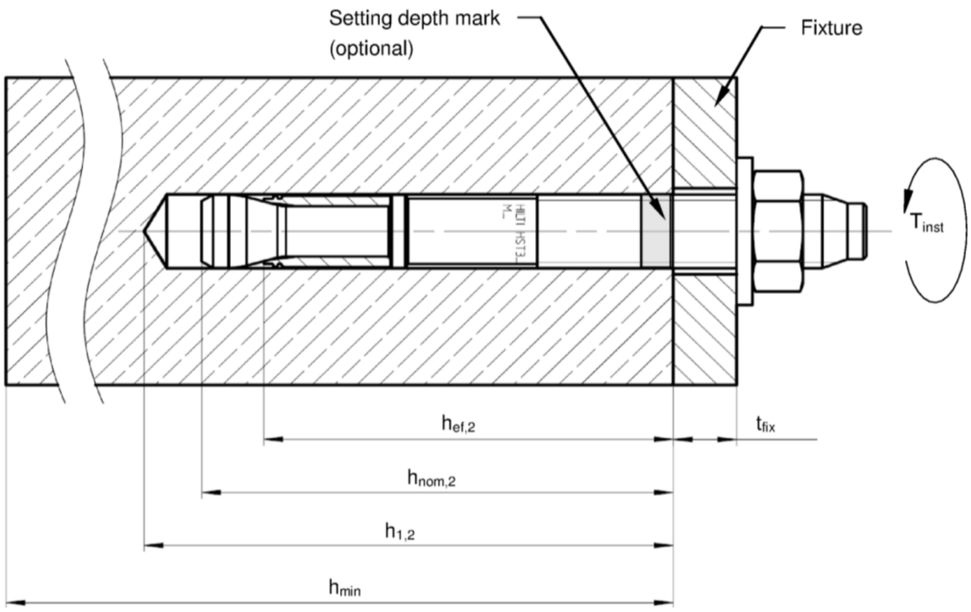


Setting information

Setting details

Setting information			Nominal anchor diameter (mm)							
			M8	M10		M12		M16		M20
Nominal drill bit diameter	d_o	mm	8	10		12		16		20
Effective minimum embedment	h_{ef}	mm	47	40	60	50	70	65	85	101
Nominal minimum embedment	h_{nom}	mm	54	48	68	60	80	78	98	116
Minimum hole depth in concrete [a)]	h_1	mm	59	53	73	68	88	86	106	124
Fixture hole diameter	d_f	mm	9	12		14		18		22
Maximum thickness of fixture	$t_{fix,max}$	mm	195	220		270		370		310
Installation torque	T_{inst}	Nm	20	45		60		110		180
Length of expansion sleeve	ℓ_s	mm	13.6	16.0		20.0		25.0		28.3
Diameter of washer	$d_W \geq$	mm	5.60	6.94		8.22		11.00		14.62
Width across flats of nut	S_W	mm	13	17		19		24		30

a) When diamond core drilling is used, add 5mm to h_1 for M8 and M10, and add 2mm to h_1 for M12 to M20.



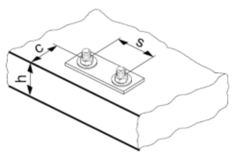
Installation equipment

Anchor size	M8	M10	M12	M16	M20
Rotary hammer	TE2(-A) – TE30(-A)				TE40 – TE80
Diamond coring tool	DD EC-1 coring tool with DD-C … TS/TL or T2/T4 core bits DD 30-W coring tool with C+ … SPX-T core bits				
Setting tool	Hilti S7W 6AT 22A – SI-AT-A22			-	
Hollow drill bit	-		TE-CD, TE-YD		
Other tools	hammer, torque wrench, blow out pump				

Setting parameters [a)]

Anchor size			M8	M10	M12	M16	M20
Effective minimum embedment	hef	mm	-	40	50	65	-
Minimum concrete thickness	hmin	mm	-	80	100	120	-
HST3 and HST3-R							
Minimum edge distance	c_{min}	mm	-	50	60	65	-
	for s ≥	mm	-	190	215	240	-
Minimum anchor spacing	s_{min}	mm	-	50	55	75	-
	for c ≥	mm	-	95	110	140	-
Effective minimum embedment	$h_{ef,\ min}$	mm	47	60	70	85	101
Minimum concrete thickness	h_{min}	mm	80	100	120	140	160
HST3							
Minimum edge distance	c_{min}	mm	40	60	60	65	120
	for s ≥	mm	65	90	155	185	180
Minimum anchor spacing	s_{min}	mm	35	40	50	80	120
	for c ≥	mm	55	100	115	135	180
HST3-R							
Minimum edge distance	c_{min}	mm	40	60	60	65	120
	for s ≥	mm	80	90	155	185	180
Minimum anchor spacing	s_{min}	mm	35	40	50	80	120
	for c ≥	mm	70	100	115	135	180
Effective minimum embedment	$h_{ef,\ min}$	mm	47	60	70	85	101
Minimum concrete thickness	h_{min}	mm	100	120	140	160	200
HST3							
Minimum edge distance	c_{min}	mm	40	50	55	65	80
	for s ≥	mm	75	150	135	175	195
Minimum anchor spacing	s_{min}	mm	35	40	60	65	90
	for c ≥	mm	60	70	80	105	130
HST3-R							
Minimum edge distance	c_{min}	mm	40	50	55	65	80
	for s ≥	mm	50	105	110	175	180
Minimum anchor spacing	s_{min}	mm	35	40	60	65	90
	for c ≥	mm	50	70	70	105	130

a) Linear interpolation for c_{min} and s_{min} is permitted.
For spacing (edge distance) smaller than critical spacing (critical edge distance) the design loads have to be reduced.



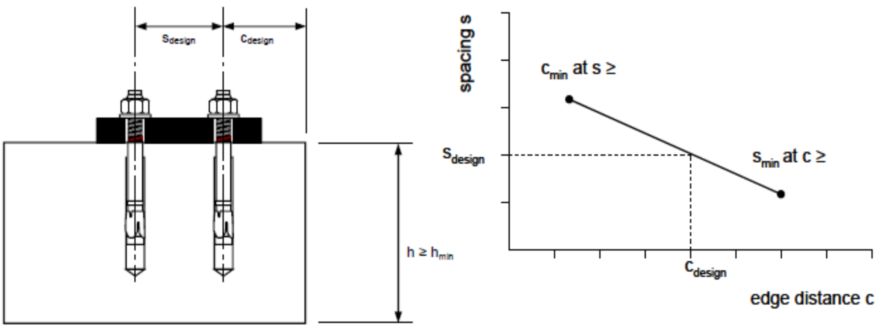


FIGURE —INTERPOLATION OF MINIMUM EDGE DISTANCE AND ANCHOR SPACING

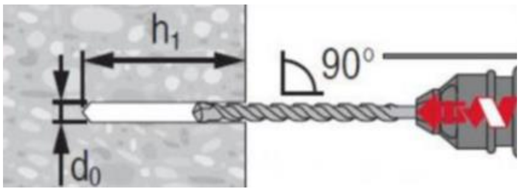
Setting instructions

***For detailed information on installation see instruction for use given with the package of the product**

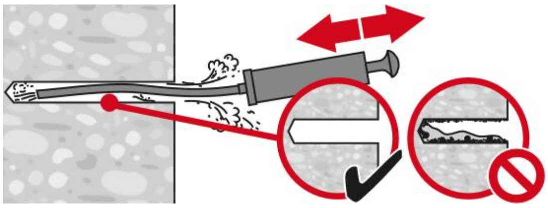
Setting instruction for HST3, HST3-R

Hammer drilling (M8, M10, M12, M16, M20)

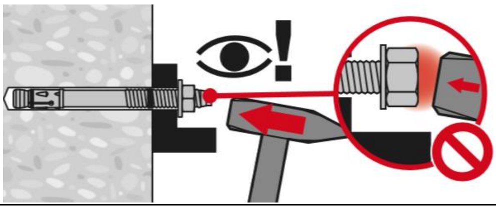
1. Drill the hole



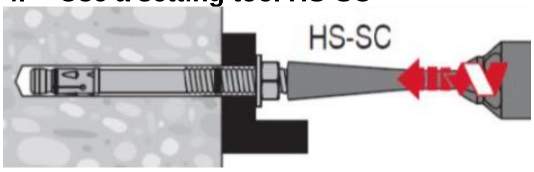
2. Clean the hole



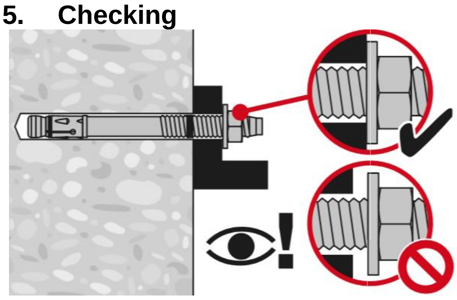
3. Insert the anchor



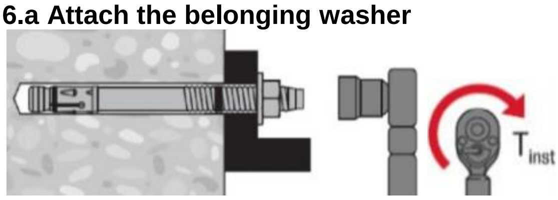
4. Use a setting tool HS-SC



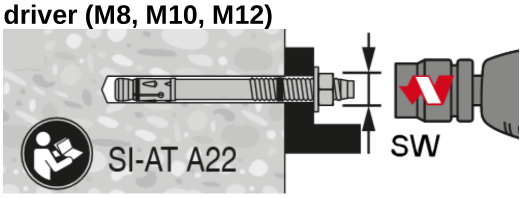
5. Checking



6.a Attach the belonging washer

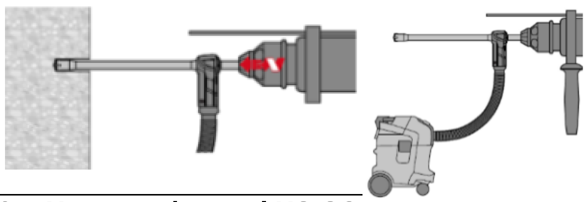


6.b Attach the belonging washer with screw driver (M8, M10, M12)

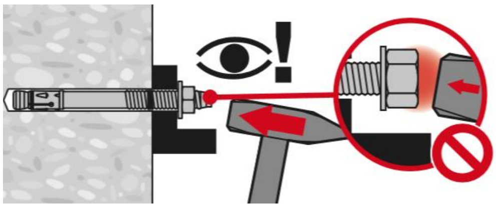


Hollow Drill Bit (M16, M20), no cleaning required

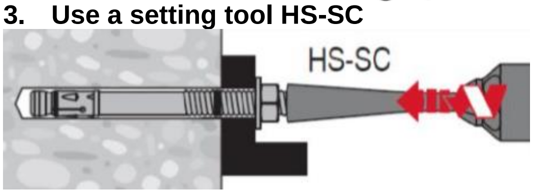
1. Drill the hole with the Hollow drill bit



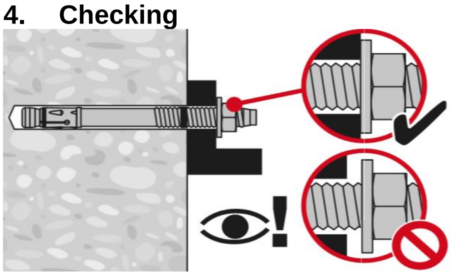
2. Insert the anchor



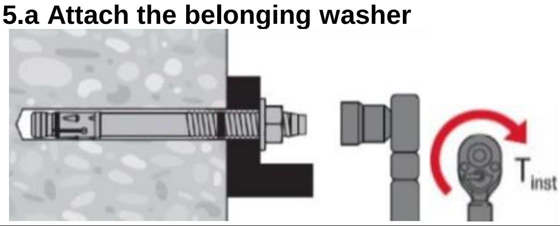
3. Use a setting tool HS-SC



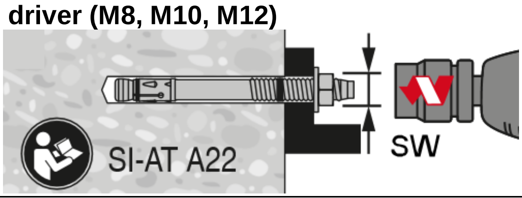
4. Checking



5.a Attach the belonging washer

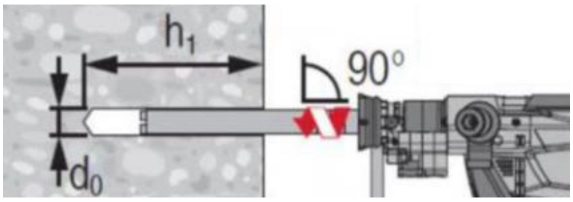


5.b Attach the belonging washer with screw driver (M8, M10, M12)

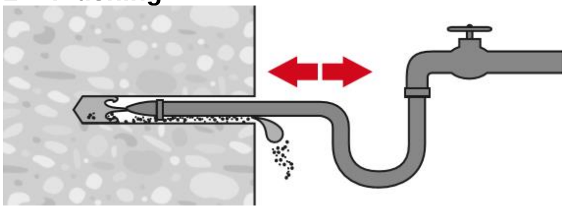


Diamond coring (M8, M10, M12, M16, M20)	

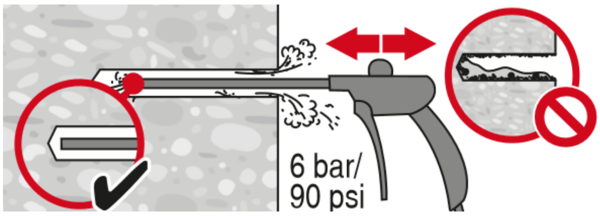
1. Core the hole



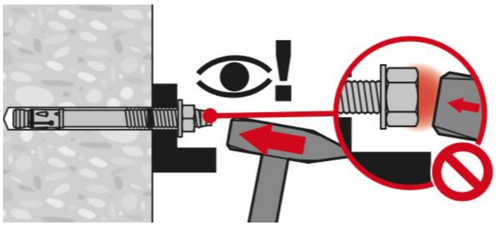
2. Flushing



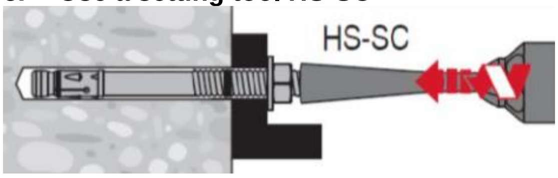
3. Clean the hole



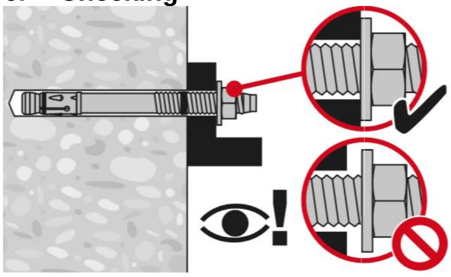
4. Insert the anchor



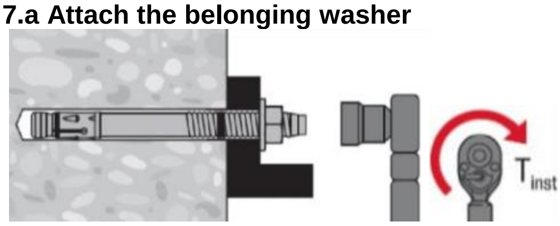
5. Use a setting tool HS-SC



6. Checking



7.a Attach the belonging washer



7.b Attach the belonging washer with screw driver (M8, M10, M12)